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ADDRESS OF THE PRESIDENT OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

THE British Association for the Advancement of Science owes its origin, and, in great measure, its specific aims and functions, to the public spirit and zeal for the interests of science of Scotsmen. Its virtual founder was Sir David Brewster; its scope and character were defined by Principal Forbes. In constitution it differed from the migratory scientific associations existing on the Continent, which mainly served to promote the social intercourse of their members by annual gatherings, in that it was to be a permanent organization, with a settled establishment and headquarters, which should have not merely its yearly reunions, but which, "by methods and by influence peculiarly its own, should continue to operate during the intervals of these public assemblies, and should aspire to give an impulse to every part of the scientific system; to mature scientific enterprise; and to direct the labors requisite for discovery."

Although, for reasons of policy, it was decided that its first meeting of September 27, 1831, should be held at York, as the most central city for the three kingdoms, and its second and third meetings at the ancient Universities of Oxford and Cambridge respectively, it was inevitable that the association should seize the earliest opportunity to visit the metropolis of Scotland where, as an historical fact, it may be said to have had its origin.

The meeting in this city of September 8, 1834, was noteworthy for many reasons. It afforded the first direct proof that the association was fulfilling its purpose. This was shown by the popular appreciation which attended its activities, by the range and charac-

[1] Read at the Edinburgh meeting, September 7, 1921.

ter of its reports on the state and progress of science, by the interest and value of its sectional proceedings, and by the mode in which its funds were employed. In felicitous terms the president of the preceding year, the Rev. Professor Sedgwick, congratulated the gathering "on the increased strength in which they had assembled, in a place endeared to the feelings of every lover of science by so many delightful and elevating recollections, especcially by the recollection of the great men whom it had fostered, or to whom it had given birth." In a few brief sentences Professor Sedgwick indicated the great power which this association is able to apply towards the advancement of science by combination and united action, and he supported his argument by pointing to the results which it had already achieved during the three short years of its existence. Professor Sedgwick's words are no less true to-day. His contention that one of the most important functions of this philosophical union is to further what he termed the "commerce of ideas" by joint discussions on subjects of kindred interest, has been endorsed by the recent action of the council in bringing the various sections into still closer touch with each other with a view to the discussion of common problems of general interest. This slight reorganization of the work of the sections, which is in entire accord with the spirit and aims of the association, as defined by its progenitors and formulated in its constitution, will take effect during the present meeting. Strictly speaking, such joint sectional discussions are not unknown in our history, and their utility and influence have been freely recognized. But hitherto the occasions have been more or less informal. They are now, it is hoped, to be part of the regular official procedure of the meetings, to which it is anticipated they will afford additional interest and value.

Another noteworthy change in our procedure is the introduction of discussions on the addresses of the presidents of sections. Hitherto these addresses have been formally read and never discussed. To the extent that they have been brief chronicles of the progress of the special departments of science with which the section is concerned they have given but little opportunity for discussion. With the greatly increased facilities which now exist for every worker to keep himself informed of the development of the branch of knowledge in which he is more particularly interested, such *résumés* have in great measure lost their true purpose, and there has, consequently, been a growing tendency of late years for such presidential addresses to deal with contemporary topics of general interest and of fundamental importance, affording ample opportunity for a free exchange of opinion. The experiment will certainly conduce to the interest of the proceedings of the sections, and will contribute to the permanent value of their work. We see in these several changes the development of ideas connected with the working of the association which may be said to have had their birth at its first meeting in Edinburgh, eighty-seven years ago.

Sixteen years later, that is on July 21, 1850, Edinburgh again extended her hospitality to the British Association, which then honored itself by electing the learned principal of the United Colleges of St. Salvator and St. Leonard, St. Andrews, to the presidential chair—at once a tribute to Sir David Brewster's eminence as a natural philosopher, and a grateful recognition of his services to this body in suggesting and promoting its formation.

On the occasion of his inaugural address, after a brief account of recent progress in science, made with the lucidity of expression which characterized all the literary efforts of the learned biographer of Newton and versatile editor of the *Edinburgh Encyclopedia,* the *Edinburgh Magazine,* and the *Edinburgh Journal of Science,* the president dwelt upon the beneficent influence of the association in securing a more general attention to the objects of science, and in effecting a removal of disadvantages of a public kind that impeded its progress. It was largely to the action of the association, assisted by the writings and personal exertions of its members, that the government was induced to extend a direct na-

tional encouragement to science and to aid in its organization.

Brewster had a lofty ideal of the place of science in the intellectual life of a community, and of the just position of the man of science in the social scale. In well-weighed words, the outcome of matured experience and of an intimate knowledge of the working of European institutions created for the advancement of science and the diffusion of knowledge, he pleaded for the establishment of a national institution in Britain, possessing a class of resident members who should devote themselves wholly to science—with a place and station in society the most respectable and independent—"free alike," as Playfair put it, "from the embarrassments of poverty or the temptations of wealth." Such men, "ordained by the state to the undivided functions of science," would, he contended, do more and better work than those who snatch an hour or two from their daily toil or nightly rest.

This ideal of "combining what is insulated, and uniting in one great institution the living talent which is in active but undirected and unbefriended exercise around us," was not attained during Brewster's time; nor, notwithstanding the reiteration of incontrovertible argument during the past seventy years, has it been reached in our own.

I have been led to dwell on Sir David Brewster's association with this question of the relations of the state towards research for several reasons. Although he was not the first to raise it—for Davy more than a century ago made it the theme of presidential addresses, and brought his social influence to bear in the attempt to enlist the practical sympathy of the government—no one more consistently urged its national importance, or supported his case with a more powerful advocacy, than the principal of the University of Edinburgh. It is only seemly, therefore, that on this particular occasion, and in this city of his adoption, where he spent so much of his intellectual energy, I should specially allude to it. Moreover, we can never forget what this association owes to his large and fruitful mind. Every man is a debtor to his profession, from which he gains countenance and profit. That Brewster was an ornament to his is acknowledged by every lover of learning. That he endeavored to be a help to it was gratefully recognized during his lifetime. After his death it was said of him that the improved position of men of science in our time is chiefly due to his exertions and his example.

I am naturally led to connect the meeting of 1850 with a still more memorable gathering of this association in this city. In August, 1871—just over half a century ago—the British Association again assembled in Edinburgh under the presidency of Lord Kelvin—then Sir William Thomson. It was a historic occasion by reason of the address which inaugurated its proceedings. Lord Kelvin, with characteristic force and insistence, still further elaborated the theme which had been so signal a feature of Sir David Brewster's address twenty years previously: "Whether we look to the honor of England," he said, "as a nation which ought always to be the foremost in promoting physical science, or to those vast economical advantages which must accrue from such establishments, we can not but feel that expermiental research ought to be made with us an object of national concern, and not left, as hitherto, exclusively to the private enterprise of self-sacrificing amateurs, and the necessarily inconsecutive action of our present governmental departments and of casual committees."

Lord Kelvin, as might have been anticipated, pleaded more especially for the institution of physical observatories and laboratories for experimental research, to be conducted by qualified persons, whose duties should be not teaching, but experimenting. Such institutions as then existed, he pointed out, only afforded a very partial and inadequate solution of a national need. They were, for the most part, "absolutely destitute of means, material, or *personnel* for advancing science, except at the expense of volunteers, or of securing that volunteers should be found to continue such little work as could then be carried on."

There were, however, even then, signs that the bread cast upon the waters was slowly re-

turning after many days. The establishment of the Cavendish Laboratory at Cambridge, by the munificence of its then chancellor, was a notable achievement. Whilst in its constitution as part of a university discipline it did not wholly realize the ideal of the two presidents, under its successive directors, Professor Clerk-Maxwell, the late Lord Rayleigh, and Sir J. J. Thomson, it has exerted a profound influence upon the development of experimental physics, and has inspired the foundation of many similar educational institutions in this country. Experimental physics has thus received an enormous impetus during the last fifty years, and although in matters of science there is but little folding of the hands to sleep, "the divine discontent" of its followers has little cause for disquietude as regards the position of physics in this country.

In the establishment of the National Physical Laboratory we have an approach to the ideal which my predecessors had so earnestly advocated. Other presidents, among whom I would specially name the late Sir Douglas Galton, have contributed to this consummation. The result is a remarkable testimony to the value of organized and continuous effort on the part of the British Association in forming public opinion and in influencing departmental action. It would, however, be ungrateful not to recall the action of the late Lord Salisbury—himself a follower of science and in full sympathy with its objects—in taking the first practical steps towards the creation of this magnificent national institution. I may be allowed, perhaps, to refer to this matter, as I have personal knowledge of the circumstances, being one of the few survivors of the committee which Lord Salisbury caused to be formed, under the chairmanship of the late Lord Rayleigh, to inquire and report upon the expediency of establishing an institution in Great Britain upon the model of certain state-aided institutions already existing on the continent, for the determination of physical constants of importance in the arts, for investigations in physical problems bearing upon industry, for the standardization and verification of physical instruments, and for the general purposes of metrology. I do not profess to give the exact terms of the reference to the committee, but, in substance, these were recognized to be the general aims of the contemplated institute. The evidence we received from many men of science, from departmental officers, and from representatives of engineering and other industrial establishments was absolutely unanimous as to the great public utility of the projected laboratory. It need hardly be said that the opportunity called forth all the energy and power of advocacy of Lord Kelvin, and I well remember with what strength of conviction he impressed his views upon the committee. That the National Physical Laboratory has, under the ability, organizing power, and business capacity of its first director, Sir Richard Glazebrook, abundantly justified its creation is recognized on all hands. Its services during the four years of war alone are sufficient proof of its national value. It has grown to be a large and rapidly increasing establishment, occupying itself with an extraordinary range of subjects, with a numerous and well-qualified staff, engaged in determinative and research work on practically every branch of pure and applied physics. The range of its activities has been further increased by the establishment since the war of coordinating research boards for physics, chemistry, engineering and radio-research. Government departments have learned to appreciate its services. The photometry division, for example, has been busy on experiments on navigation lamps for the Board of Trade, on miners' lamps for the Home Office and on motor-car head-lamps for the Ministry of Transport, and on the lighting of the National Gallery and the Houses of Parliament. Important work has been done on the forms of ships, on the steering and manœuvring of ships, on the effect of waves on ship resistance, on the interaction between passing ships, on seaplane floats, and on the hulls of flying-boats.

It is also actively engaged in the study of problems connected with aviation, and has a well-ordered department of aerodynamical research.

It can already point to a long and valuable

series of published researches, which are acknowledged to be among the most important contributions to pure and applied physics which this country has made during recent years.

I may be pardoned, I hope, for another personal reference, if I recall that it was at the Edinburgh meeting, under Lord Kelvin's presidency, fifty years ago, that I first became a member of this association, and had the honor of serving it as one of the secretaries of its chemical section. Fifty years is a considerable span in the life of an individual, but it is a relatively short period in the history of science. Nevertheless, those fifty years are richer in scientific achievement and in the importance and magnitude of the utilitarian applications of practically every branch of science than any preceding similar interval. The most cursory comparison of the state of science, as revealed in his comprehensive address, with the present condition of those departments on which he chiefly dwelt, will suffice to show that the development has been such that even Lord Kelvin's penetrative genius, vivid imagination, and sanguine temperament could hardly have anticipated. No previous half-century in the history of science has witnessed such momentous and far-reaching achievements. In pure chemistry it has seen the discovery of argon by Rayleigh, of radium by Madame Curie, of helium as a terrestrial element by Ramsay, of neon, xenon, and krypton by Ramsay and Travers, the production of helium from radium by Ramsay and Soddy, and the isolation of fluorine by Moissan. These are undoubtedly great discoveries, but their value is enormously enhanced by the theoretical and practical consequences which flow from them.

In applied chemistry it has witnessed the general application of the Gilchrist-Thomas process of iron-purification, the production of calcium cyanamide by the process of Frank and Caro, Sabatier's process of hydrogenation, a widespread application of liquefied gases, and Haber's work on ammonia synthesis—all manufacturing processes which have practically revolutionized the industries with which they are concerned.

In pure physics it has seen the rise of the electron theory, by Lorentz; Hertz's discovery of electro-magnetic waves; the investigation of cathode rays by Lenard, and the elucidation of crystal structure by Bragg.

It has seen, moreover, the invention of the telephone, the establishment of incandescent lighting, the electric transmission of force, the invention of the cinematograph, of wireless telegraphy, the application of the Röntgen rays, and the photographic reproduction of color.

In physical chemistry it has witnessed the creation of stereo-chemistry by Van't Hoff and Le Bel, Gibbs's work on the phase rule, Van't Hoff's theory of solutions, Arrhenius's theory of ionic dissociation, and Nernst's theory of the galvanic cell.

Such a list is far from complete, and might be greatly extended. But it will at least serve to indicate the measure of progress which the world owes to the development and application during the last fifty years of the two sciences —physics and chemistry—to which Lord Kelvin specially referred.

The more rapid dissemination of information concerning the results of recent or contemporary investigation, which Lord Kelvin so strongly urged as "an object to which the powerful action of the British Association would be thoroughly appropriate," has been happily accomplished. The timely aid of the association in contributing to the initial expense of preparing and publishing monthly abstracts of foreign chemical literature by the Chemical Society is gratefully remembered by British chemists. The example has been followed by the greater number of our scientific and technical societies, and the results of contemporary inquiry in every important branch of pure and applied science are now quickly brought to the knowledge of all interested workers. In fact, as regards the particular branch of science with which I am more directly concerned, the arrangements for the preparation and dissemination of abstracts of contemporary foreign chemical literature are proving to be a veritable embarrassment of riches, and there is much need for cooperation

among the various distributing societies. This need is especially urgent at the present time owing to the greatly increased cost of paper, printing, binding, and indeed of every item connected with publication, which expense, of course, ultimately falls upon the various societies and their members. The problem, which has already received some attention from those entrusted with the management of the societies referred to, is not without its difficulties, but these are not insoluble. There is little doubt that a resolute and unanimous effort to find a solution would meet with success.

The present high cost of book production, which in the case of specialized books is about three times what it was in 1914, is exercising a most prejudicial effect upon the spread of scientific knowledge. Books on science are not generally among the "best sellers." They appeal to a comparatively limited and not particularly wealthy public, largely composed of the professional classes who have suffered in no small measure from the economic effects of the war. The present high price of this class of literature is to the public detriment. Eventually it is no less to the detriment of the printing and publishing trades. Publishers are well aware of this fact, and attempts are being made by discussions between employers and the executives of the Typographical Association and other societies of compositors to reach an equitable solution, and it is greatly to be hoped that it will be speedily found.

All thinking men are agreed that science is at the basis of national progress. Science can only develop by research. Research is the mother of discovery, and discovery of invention. The industrial position of a nation, its manufactures and commerce, and ultimately its wealth, depend upon invention. Its welfare and stability largely rest upon the equitable distribution of its wealth. All this seems so obvious, and has been so frequently and so convincingly stated, that it is superfluous to dwell upon it in a scientific gathering to-day.

A late distinguished admiral, you may remember, insisted on the value of reiteration. On this particular question it was never more needed than now. The crisis through which we have recently passed requires it in the interests of national welfare. Of all post-war problems to engage our serious attention, none is more important in regard to our position and continued existence than the nation's attitude toward science and scientific research, and there is no more opportune time than the present in which to seek to enforce the teaching of one of the most pregnant lessons of our late experience.

It is, unfortunately, only too true that the industrial world has in the past underrated the value of research. One indication that the nation is at length aroused to its importance is to be seen in the establishment of the Department of Scientific and Industrial Research, with its many subordinate associations. The outbreak of the Great War, and much in its subsequent history, revealed, as we all know, many national shortcomings, due to our indifference to and actual neglect of many things which are at the root of our prosperity and security. During the war, and at its close, various attempts, more or less unconnected, were made to find a remedy. Of the several committees and boards which were set up, those which still exist have now been coordinated, and brought under the control of a central organization—the Department of Scientific and Industrial Research. Research has now become a national and state-aided object. For the first time in our history its pursuit with us has been organized by government action. As thus organized it seeks to fulfil the aspirations to which I have referred, whilst meeting many of the objections which have been urged against the endowment of research. It must be recognized that modern ideas of democracy are adverse to the creation of places to which definite work is not assigned and from which definite results do not emanate. This objection, which strikes at the root of the establishment of such an institution as Sir David Brewster contemplated, is, to a large extent, obviated by the scheme of the Department of Scientific and Industrial Research. It does not prescribe or fetter research, but, whilst aiding by personal payments the individual worker, leaves him free to pursue his inquiry

as he thinks best. Grants are made, on the recommendation of an advisory council of experts, to research workers in educational institutions and elsewhere, in order to promote research of high character on fundamental problems of pure science or in suitable cases on problems of applied science. Of the boards and committees and similar organizations established prior to or during the war, or subsequent to it, with one or two exceptions, all are now directly under the department. They deal with a wide range of subjects, such as the Building Research Board, established early in 1920 to organize and supervise investigations on building materials and construction, to study structural failures, and to fix standards for structural materials. The Food Investigation Board deals with the preservation by cold of food, and with the engineering problems of cold storage, with the chemistry of putrefaction, and the agents which induce it, with the bionomics of moulds, and the chemistry of edible oils and fats. The Fuel Research Board is concerned with the immediate importance of fuel economy and with investigations of the questions of oil-fuel for the navy and mercantile marine, the survey of the national coal resources, domestic heating, air pollution, pulverized fuel, utilization of peat, the search for possible substitutes for natural fuel oil, and for practicable sources of power alcohol.

The Geological Survey Board has taken over the Geological Survey of Great Britain and the control of the Museum of Practical Geology. The maintenance of the National Physical Laboratory, originally controlled by a general board and an executive committee appointed by the president and council of the Royal Society, is now transferred to the Department of Scientific and Industrial Research. A Mines Research Committee and a Mine Rescue Apparatus Committee are attached to the department. The former is concerned with such questions as the determination of the geothermic gradient, the influence of temperature of intake and return air on strata, the effect of seasonal changes on strata temperature of intakes, the cooling effect due to the evolution of fire-damp, heat production from the oxidation of timber, etc. The department is also directing inquiries on the preservation and restoration of antique objects deposited in the British Museum. It is concerned with the gauging of rivers and tidal currents, with special reference to a hydrographical survey of Great Britain in relation to the national resources of water-power. In accordance with the government policy, four coordinating boards have been established to organize scientific work in connection with the fighting forces, so as to avoid unnecessary overlapping and to provide a single direction and financial control. The four boards deal, respectively, with chemical and physical problems, problems of radio-research, and engineering. These boards have attached to them various committees dealing with special inquiries, some of which will be carried out at the National Physical Laboratory. The government have also authorized the establishment of a Forest Products Research Board.

The department is further empowered to assist learned or scientific societies and institutions in carrying out investigations. Some of these were initiated prior to the war, and were likely to be abandoned owing to lack of funds. Whenever the investigation has a direct bearing upon a particular industry that had not hitherto been able to establish a research association, it has been a condition of a grant that the institution directing the research should obtain contributions towards the cost on a £ for £ basis, either directly through its corporate funds or by special subscriptions from interested firms. On the formation of the appropriate association the research is, under suitable safeguards, transferred to it for continuance. The formation of a number of research associations has thus been stimulated, dealing, for example, with scientific instruments, non-ferrous metals, glass, silk, refractories, electrical and allied industries, pottery, etc.

Grants are made to research associations formed voluntarily by manufacturers for the purposes of research, from a fund of a million sterling, placed at the disposal of the research department for this purpose. Such associa-

tions, to be eligible for the grant, must submit articles of association for the approval of the department and the Board of Trade. If these are approved, licenses are issued by the Board of Trade recognizing the associations as limited liability companies working without profits. Subscriptions paid to an association by contributing firms are recognized by the Board of Inland Revenue as business costs of the firms, and are not subject to income or excess profits taxes. The income of the association is similarly free of income tax. Grants are ordinarily made to these associations on the basis of £1 for every £1 raised by the association between limits depending upon the particular industry concerned. In the case of two research associations grants are made at a higher rate than £ for £, as these industries are regarded as having a special claim to state assistance on account of their "pivotal" character. The results of research are the sole property of the association making them, subject to certain rights of veto possessed by the department for the purposes of ensuring that they are not communicated to foreign countries, except with the consent of the department, and that they may be made available to other interested industries and to the government itself on suitable terms.

These arrangements have been found to be generally satisfactory, and at the present time twenty-four of such research associations have been formed to whom licenses have been issued by the Board of Trade. Others are in process of formation, and may be expected to be at work at an early date. These research associations are concerned with nearly all our leading industries. The official addresses of most of them are in London; others have their headquarters in Manchester, Leeds, Sheffield, Birmingham, Northampton, Coventry, Glasgow, and Belfast.

The department has further established a Records Bureau, which is responsible for receiving, abstracting, filing and collating communications from research workers, boards, institutions, or associations related to or supervised by the department. This information is regarded as confidential, and will not be communicated except in writing, and after consultation with the research worker or organization from which it has been received. Also such non-confidential information as comes into the possession of the department which is of evident or probable value to those working in touch with the department is collected and filed in the bureau and made generally available.

It is also a function of the bureau to effect economy in preventing repetition and overlapping of investigations and in ensuring that the fullest possible use is made of the results of research. Thus, the programmes of research associations are compared in order to ensure that researches are not unwittingly duplicated by different research associations. Sometimes two or more research associations may be interested in one problem from different points of view, and when this occurs it may be possible for the bureau to arrange a concerted attack upon the common problem, each research association undertaking that phase of the work in which it is specially interested and sharing in the general results.

As researches carried out under the department frequently produce results for which it is possible to take out patents, careful consideration has been given to the problems of policy arising on this subject, and other government departments also interested have been freely consulted. As the result, an interdepartmental committee has been established with the following terms of reference:—

1. To consider the methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged (*a*) as research workers, or (*b*) in some other technical capacity, so as to give a fair reward to the inventor and thus encourage further effort, to secure the utilization in industry of suitable inventions and to protect the national interest, and

2. To outline a course of procedure in respect of inventions arising out of state-aided or supported work which shall further these aims and be suitable for adoption by all government departments concerned.

About forty patents have been taken out by the department jointly with the inventors and

other interested bodies, but of these, nine have subsequently been abandoned. At least five patents have been developed to such a stage as to be ready for immediate industrial application.

It will be obvious from this short summary of the activities of the department, based upon information kindly supplied to me by Sir Francis Ogilvie, that this great scheme of state-aided research has been conceived and is administered on broad and liberal lines. A considerable number of valuable reports from its various boards and committees have already been published, and others are in the press, but it is, of course, much too soon to appreciate the full effects of their operations. But it can hardly be doubted that they are bound to exercise a profound influence upon industries which ultimately depend upon discovery and invention. The establishment of the department marks an epoch in our history. No such comprehensive organization for the application of science to national needs has ever been created by any other state. We may say we owe it directly to the Great War. Even from the evil of that great catastrophe there is some soul of goodness would we observingly distil it out.

T. EDWARD THORPE

(To be concluded)

LIFE IN OTHER WORLDS

DOES life—especially intelligent life—exist elsewhere than on the earth? Three letters in recent numbers of SCIENCE discuss this age-old problem. And it is noticeable that, as usual, the astronomers take the affirmative and the biologists the negative side of the argument. There may be two reasons for this.

1. Astronomers, physicists, mathematicians, are accustomed to hold a more receptive attitude, an open mind, toward hypotheses that can not be definitely disproved. This frame of mind is natural and adapted to their work. They are accustomed to deal with problems which can be solved by mathematical and deductive methods. A limited number of solutions appear, all of them to be receptively considered until they can be definitely disproved.

The biologist, on the other hand, deals with a different sort of problem. His evidence is almost always inductive, experimental. His subjects are far too complex, too little understood, to admit of mathematical analysis, save in their simpler aspects. And always he is compelled to adopt toward the illimitable numbers of possible explanations, a decidedly exclusive attitude, and to leave out of consideration all factors that have not something in the way of positive evidence for their existence. If he fails to do so, he soon finds himself struggling hopelessly in a bog of unprofitable speculations. A critical rather than a receptive frame of mind is the fundamental condition of progress in his work.

2. The second reason is that the astronomer or cosmologist has in mind when he thinks of this problem, the physical and chemical conditions that would render life possible. If these be duplicated elsewhere he sees life as possible, and by the incidence of the laws of chance probable or almost certain, if they be duplicated often enough. Viewing the innumerable multitude of stars, each of them a solar system with possible or probable planets analogous to our own, he sees such multitudinous duplications of the physical conditions that have made life possible on our earth, that it appears to him incredible that all stand empty and lifeless.

The biologist, on the other hand, has at the forefront of his mind the history and evolution of life on the earth. He knows that although these conditions favoring the creation of living matter have existed on earth for many millions or hundreds of millions of years, yet life has not come into existence on earth save once, or at most half a dozen times, during that time. The living beings on earth are reducible at most to a few and probably to one primary stock, all their present variety being the result of the evolutionary processes of differentiation and adaptation. It must appear therefore to him that the real conditions for the creation of life on earth have involved, not merely the favoring physical conditions, but some immensely complex concatenation of circumstances so rare that even

on earth it has occurred probably but once during the æons of geologic time. The marvelous complexity of the fundamental substance of life, so complex even in its simplest forms that his most precise and elaborate methods of analysis give him but a partial and tentative comprehension of its real structure, must needs strengthen his concept of the immense complexity of the conditions necessary to its creation and evolution. If these conditions have not been duplicated on earth during the whole of the recorded history of life from the Cambrian down to the present day, it appears to him infinitely less probable that they have been duplicated elsewhere than on the earth.

That the "man in the street" should be sympathetic with the astronomer's rather than the biologist's conclusion is natural enough. The physical probabilities are obvious enough to all; the complexity of life and its conditions he does not realize; nor does he sense the minute relative proportion of time during which intelligent life has existed upon earth, or the vast and impassable barriers of space that preclude the transfer of organized matter from star to star. Moreover, to admit the probability of extra-mundane life opens the way for all sorts of fascinating speculation in which a man of imaginative temperament may revel free from the checks and barriers of earthly realities.

Such life, if it exists, would surely be evolved *ab initio* on independent lines of adaptation and the probabilities would be overwhelming that the results of the æons of its evolution, if by some rare chance it developed intelligent life simultaneously with its appearance on the earth, would be a physical and intellectual type so different fundamentally from our own as to be altogether incomprehensible to us even if we recognized it as being intelligence or life at all. Who that has studied the ant or the bee has failed to be impressed with the unplumbed mysteries in its sensations, its psychology, its inner life! We are far from any full understanding of the intelligence, if I may use the word, of the social insects, relatives, albeit distant relatives, of our own, brought up under the identical environment of terrestrial conditions. How much farther would we be from any comprehension of the intellectual processes of a race of beings whose ultimate origin was wholly different from ours, whose evolution was shaped under conditions that, however closely parallel, could not have been identical with those of the earth. Indeed, if we are to take a receptive attitude in this matter, why limit ourselves to protoplasm as the basis of life? What reason have we to suppose that a self-perpetuating substance, capable of acquiring the heterogeneity of function, the multiple complexity of structural adaptation, the specialization of parts, the elaboration of control and correlation organs, and finally the dominance of these last and development of conscious and intelligent beings, must necessarily be based upon the semi-liquid jelly upon which life, as we know it, is fundamentally based? Other substances, solid, liquid, or even gaseous, may have similar capacities, may have carried them out under different conditioning laws, to a result equally complex and marvelous. We know of nothing of the sort. But would we know of it if it existed, even if it existed upon earth? Would there be any conceivable method of communication, any common ideas, interests, or activities, between such beings and ourselves? It does not appear probable. How much less the probability of communication across the void of interplanetary space.

To suppose that parallel evolution could go so far as to produce similar methods of exploiting the earth to those used by civilized man—irrigation canals, cities, or other such phenomena of the immediate present—in life evolved independently in different planets—and to produce them at an identical moment in geologic time—would seem to be the result of those limitations of constructive or creative thought which are characteristic of myth and fairy-tale, of the anthropomorphic god, or the animal that thinks and talks like a man. Civilized men cannot form any real concept of intelligent life on Mars save in terms of civilized life on earth. Yet, so far as we may judge

from earth conditions, if life exists at all on Mars, it is a thousand to one that it is not intelligent life, for intelligent life on earth is a phenomenon that has existed for about a thousandth part of the geologic record of life. And it is a hundred thousand to one that it is not civilized life, for civilized life has existed at the utmost for a hundredth part of the time that man as such has been on the earth. Could we view the earth from without at any earlier portion of her history, we would by no means conclude that the existence of life must needs involve or culminate in the existence of intelligent life, still less of civilization. We have no means of knowing whether its existence at the present moment is a transitory episode or the commencement of a new era. But if it be the latter, it is probable that the external evidences of civilization a hundred centuries in the future would be as incomprehensible to us to-day, as impossible to interpret in the light of our present knowledge and customs, as our modern civilization would be to the pithecanthropos or the chimpanzee. Does any one seriously suppose, after considering the trends and progress of the last few centuries, that our descendants a thousand centuries hence will still be growing grain and irrigating fields for human provender? Such primitive expedients in food production will probably be obsolete in a hundredth part of that time. Life on earth at any other moment than the immediate present would not be indicated to an outsider by any such evidence as our present civilization might afford. Nor is it in the least probable that life upon another planet would be indicated by such evidence at any stage of its existence, or would have any resemblance to our own sufficient for us to recognize it.

In sum it appears to me as a paleontologist that

1. The complex concatenation of circumstances necessary to bring about the initiation of life has occurred upon earth half a dozen times at most, probably but once, in an environment that has apparently been favorable for a thousand million years. The probability of its occurring in a substantially similar environment upon another planet is so slight as to be practically reducible to a mathematical zero in any particular instance.

2. The number of solar systems being almost infinite, we might regard the number of such possible favorable environments as amounting practically to infinity.

3. The resultant of these two considerations is that there is a finite and reasonable chance that life has existed or will exist somewhere else in the universe than on this earth alone.

4. The probability that intelligent life exists is vastly less, and that anything in the least analogous to our civilization exists at the present time is so slight as to be negligible.

5. If any life involving the development of self-consciousness, of abstract thought and introspection analogous to the higher intelligence of mankind, or the control of environment and utilization of natural resources that we call civilization, should develop independently upon some other planet out of the preexisting simpler phases of life, it probably—almost surely—would be so remote in its fundamental character and its external manifestations from our own, that we could not interpret or comprehend the external indications of its existence, nor even probably observe or recognize them.

6. In any specific instance, such as other planets of our own system, the probabilities of the existence of any kind of life amount to practically zero. The probabilities of an intelligent life upon Mars or Venus or elsewhere in our system so similar to our own in its character and manifestations as to be indicated by irrigation canals, cities, or other manifestations of human civilization, appears to be zero of the second degree. The most that one can allow as a reasonable possibility is that there may be some form of life existing somewhere else in the universe than upon our planet. That we have or shall ever get evidence of its existence appears to me practically impossible in the light of present knowledge and limitations.

W. D. MATTHEW

THE AMERICAN MUSEUM OF NATURAL HISTORY

GEORGE TRUMBULL LADD

George Trumbull Ladd, for forty years professor of moral philosophy and metaphysics at Yale University, died on August 8, at the age of eighty-one years.

In the eighties and nineties, Ladd was a towering figure, through his academic leadership, in the introduction of the new psychology. This was the period in which physiological, experimental, genetic and abnormal psychology gained recognition in the college curriculum of this country, and Ladd did much to bring this recognition. Yet, he was not primarily a psychologist and did no experimental work in any of the fields which he so ably introduced. He came into psychology through philosophy, and had come into philosophy through theology. History will probably recognize him as an organizer rather than an inspirer, or an original contributor in specific problems.

While always regarded as more or less dry, his books and lectures were characterized by remarkable clearness, accuracy, thoroughness, broadmindedness and chasteness of style and a pleasing absence of the irrelevant. His definitions were those of a logician; his scientific perspective was that of a philosopher; his power of appeal was that of the forceful teacher. The fidelity and constructive analysis with which he interpreted the findings of research men in physiology, physics, medicine and genetics gave dignity and permanence to his work. The encyclopedic character of his work shows him at his best in his power to organize for himself and put in teachable form these new and diverse approaches to the study of the human mind. His "Elements of Physiological Psychology" and "Psychology Descriptive and Explanatory" will live as classics from that period.

His conservatism was another feature which gave his work in that period prestige and success. Wundt, Ribot, Galton, James, Hall, Cattell, Baldwin, Scripture, and others, each came out with a different brand of psychology which was bound to draw out some temporary antagonism; but Ladd welcomed all these and quieted the turbulent waters by certifying and formulating as a philosopher, as a preacher and as a teacher what was "wholesome" and giving it a setting in academic psychology. As an original thinker, Ladd's power lay not in the scientist's observation and discovery within a narrow field, but rather in the power of a great thinker to interpret and organize new and relevant facts.

His utterances on mental evolution, on mental measurement, on disorders of personality, on "psychology without a soul," make most interesting reading from the present point of view. The new points of view are all in his work, but their presentation is so sagaciously qualified as to make the present reader question whether he had actually recognized the real significance of these new concepts in psychology. Yet, it was this mode of conservative thought and guarded statement that gave stability to his teaching and made it for many years the orthodox point of view in the new psychology. He made the transition not only from philosophy to psychology but also from theology to psychology and from common sense view of daily life to scientific psychology without any break or antagonism.

Ladd's influence in psychology was cut short by an unfortunate breaking up of the department in the late nineties, which led to his premature retirement and deprived him of the contact with the younger working constituency and the opportunity of projecting himself through such a constituency. His interest then turned to interpretative psychology through his various books on psychology as applied to philosophy, ethics, æsthetics, social life, and religion. His appeal was here to the general reader, and in this field his utterances are characterized by the same traits that we found in the earlier academic period.

C. E. Seashore

The National Research Council,
Washington, D. C.,
August 20, 1921

SCIENTIFIC EVENTS

THE BRITISH IMPERIAL BUREAU OF MYCOLOGY

In 1918 the British Imperial War Conference had brought to its notice the loss to

the empire caused by fungoid diseases of plants.

A Canadian estimate places the loss in the year 1917, in the prairie region of Canada alone, at 100,000,000 bushels, worth from £25,000,000 to £50,000,000. For the same year, the loss in the five chief cereals of the United States due to this fungus was placed at 400,000,000 bushels. The annual loss on Indian wheat is estimated in millions of rupees.

A proposal was adopted for the establishment of a central organization to encourage and coordinate work throughout the Empire on fungi in relation to agriculture. The Colonial Office has brought the necessary negotiations to a successful issue, and has now formed a mycological bureau supported by contributions from the various self-governing Dominions, India, Egypt, the Sudan, and the non-self-governing Colonies and Protectorates. The precedent of the Imperial Bureau of Entomology has been followed, and the new institution is to be managed by a committee of experts under the chairmanship of Lord Harcourt. The headquarters of the bureau are to be at Kew, and it is to work in close association with the Royal Botanic Gardens, where there are already a magnificent library, laboratories, and a department for fungi in the museum.

CERAMIC INVESTIGATIONS BY THE UNITED STATES BUREAU OF MINES

A NEW ceramic laboratory, in which investigative work regarding the clays of the Northwest will be conducted, is to be installed at the Northwest Experiment Station of the United States Bureau of Mines on the campus of the University of Washington at Seattle.

The laboratory work in connection with a general study of the clays of Washington has been completed, and a bulletin on the subject of Washington clays is now in course of preparation.

At the Northwest Experiment Station an attempt is being made to remove iron and silicon from kaolin to produce either sillimanite or the oxide of aluminum. Clay was melted in an arcing furnace in presence of carbon; some silicon and iron were volatilized and some reduced to metal. The products contained less iron oxide and silica and more alumina than previously, but not in sufficient amounts to be sillimanite. The refractoriness of these products is to be determined by the ordinary tests.

A cooperative agreement has been effected between the United States Bureau of Mines and the Central of Georgia Railway for an investigation by the Ceramic Experiment Station, Columbus, Ohio, of the white clay and bauxites through central Georgia along the railroad right-of-way. R. B. Gilmore, formerly ceramic chemist with the Vesuvius Crucible Co., Swissvale, Pa., and H. M. Kraner, formerly ceramic assistant of the Bureau of Mines, have been assigned to this work. Preliminary tests on the effects of low calcination temperatures on the colloidal content of Georgia white clays have been made. By calcining Georgia clay to from 500° to 600° C. the adsorptive properties were reduced to those of the English china clay, without materially reducing its plasticity.

A microscopic examination of the mineral constituent of kaolins is being conducted at the Ceramic Experiment Station at Columbus.

THE BIOLOGY CLUB OF THE OHIO STATE UNIVERSITY

DURING the academic year of 1920–21, the Biology Club of the Ohio State University held monthly meetings from October to May, inclusive. The club, organized in 1891, is one of the oldest organizations of the university. It is composed of members of the science faculties, graduate students, and those interested in scientific research. Opportunity has been given the past year for discussions of scientific experimentation and investigation by members of the faculties, and reports of research by graduate students. The following papers were presented:

Oct. 11. Reports on a survey of Ohio fishes.
1. "Distribution of Ohio fishes," Professor R. C. Osburn.
2. "Food of the large mouth bass," E. L. Wickliff.
3. "Algal food of the gizzard shad," L. H. Tiffany.

Nov. 2. "The Hessian fly in Ohio," Professor T. H. Parks.

Dec. 6. "Some new factor relations in barley," Professor J. B. Park.

"Effect of environment on expression of characters in hybrid oats," D. M. Lutz.

Jan. 10. "The vegetation of the Lake Okoboji (Iowa) region" (lantern slides), Professor A. E. Waller.

Feb. 14. "The inferior vena cava of man and mammals—its abnormalities and their interpretation from the standpoint of their development," Professor C. F. McClure, Princeton University. (Joint meeting with the Omega Chapter of the Society of the Sigma Xi.)

Mar. 7. "The origin and development of the prairie," Professor H. C. Sampson.

Apr. 11. "Some measurements of emotional states," Professor H. E. Burtt.

"Parasites on aphids," E. A. Hartley.

May 2. "Some recent applications of physics to biological problems," Professor Alphaeus W. Smith.

"Experimental work with mealy bugs," W. S. Hough.

The president of the club for the year was Dr. C. H. Kennedy, of the department of zoology and entomology; the vice-president, Dr. J. W. Bridges, of the department of psychology, and the secretary, Dr. L. H. Tiffany, of the department of botany.

DR. CARL L. ALSBERG AND THE BUREAU OF CHEMISTRY

In formally accepting the resignation of Dr. Carl L. Alsberg as Chief of the Bureau of Chemistry, Secretary Wallace wrote him as follows:

Permit me, in formally accepting your resignation, once more to express my sincere regret that the government and this department will no longer have the benefit of your services.

Your nine years in the department have been fruitful years. You have attained a leadership in scientific work not alone in this department, but in the larger field seldom reached by men of your years. The tender of the important position which you have accepted is evidence of this.

Your administration of the food and drugs act has been characterized by tactfulness, fearlessness, justice, and common sense, and you have, therefore, commanded the confidence and respect both of those who have come under the law and of the great public whose health you have so zealously protected. Your work in this field has been an inspiration which I hope will continue with us.

It is not often that one attains such outstanding eminence in both research and administrative work.

We shall all miss you here; especially I shall miss your wise and sane counsel from which I have profited very much in the rather trying task of undertaking to qualify for a difficult and important work. I wish that you might still be within call.

Notwithstanding our regret that you are leaving the department, all of us here rejoice in the opportunity that has opened for you to pursue important research in a field in which you have such a great heart interest. We are expecting much of you; we are confident that you will make large and valuable contributions to the national welfare.

I know that I express the feelings of every one in this department when I say that our very best wishes go with you, and if at times you find that we can be of help in the work you are now undertaking, we shall expect you to call upon us with full assurance of a prompt and sympathetic response.

SCIENTIFIC NOTES AND NEWS

The American Chemical Society held last week its sixty-second meeting at Columbia University, New York City, under the presidency of Dr. Edgar Fahs Smith, provost emeritus of the University of Pennsylvania. The principal events of the program have already been recorded in Science and we hope to print in subsequent numbers accounts of the business transacted and abstracts of the papers before the sections.

The Second International Eugenics Congress meets at the American Museum of History, New York City, next week under the presidency of Dr. Henry Fairfield Osborn, with Dr. Alexander Graham Bell as honorary president. The opening meeting will be held in the Hall of the Age of Man on September 22, when addresses will be made by Dr. Osborn, Dr. Charles B. Davenport and Major Leonard Darwin.

At the meeting of the British Association for the Advancement of Science, held at Edinburgh from September 7 to 14, a joint discussion before the sections of mathematical and physical science and of chemistry on "The structure of molecules" was opened by Dr. Irving Langmuir, of the research laboratory of the General Electric Company. Others taking part in the discussion were Profes-

sor A. Smithells, Professor W. L. Bragg, Professor J. R. Partington, Professor A. O. Rankine, and Dr. S. H. C. Briggs.

THE quinquennial prize for the best work in the medical sciences, offered by the Brussels Academy of Medicine, has been awarded to Professor A. Brachet of the chair of anatomy and embryology of the University of Brussels.

FROM exchanges we learn that the University of Vienna has created an honorary title to express its gratitude to those who have aided in relieving the material distress of the university during the last few years. The honorary title has been conferred on Dr. Ferrière, the president of the International Red Cross, and Dr. Franz Boas of Columbia University besides the ambassadors of Great Britain and Sweden, Mr. Herbert Hoover, the president and ambassador of Argentina and an English woman, Lady Mary Murray.

MR. J. P. BONARDI, who has been with the Bureau of Mines Experiment Station at Denver for the past five years, has accepted a position as manager of the assay and chemical department of the Mines and Smelter Supply Co., of Denver, Colo.

MAJOR GENERAL W. L. SIBERT, head of the Chemical Warfare Service during the war, is now on his farm in Warren County, Kentucky, where some twenty oil wells are being developed.

MR. CHARLES K. WEAD, for over twenty years an examiner in the U. S. Patent Office in the Class of Music, has resigned and gone to Ann Arbor, Mich, to live.

PROFESSOR EDWARD A. WHITE, of Cornell University, has sailed for England to spend several months in study at the Royal Botanic Gardens at Kew; he will also study commercial floriculture in other parts of England and Scotland, and in Holland and Belgium.

THE advisory committee provided for by the Importation of Plumage (Prohibition) Act recently enacted by the British Parliament has been constituted as follows: Lord Crewe (chairman), Mr. E. C. Stuart Baker and Dr. W. Eagle Clarke (representing ornithology), Mr. C. F. Downham, Mr. W. G. Dunstall, and Mr. L. Joseph (representing the feather trade), Lord Buxton, Capt. E. G. Fairholme, Mrs. Reginald McKenna, and Mr. H. J. Massingham.

A MEMORIAL tablet was recently placed on the house at Enghien-les-Bains, formerly occupied by the radiologist, A. Leray, who succumbed last spring to the effects of roentgen-ray injury acquired during his work for the wounded during the war.

WE learn from *Nature* that on July 21, a memorial was unveiled in the public gardens at Dartmouth to the memory of Thomas Newcomen, the pioneer of the steam engine. Newcomen was born in Dartmouth in 1663; he followed the trade of blacksmith there, and was also a Baptist preacher.

THE Royal Photographic Society is collecting funds for a memorial at Lacock to W. H. Fox Talbot, distinguished for his work in scientific photography.

Nature announces the death, at the age of eighty-nine years, of Samuel Alfred Varley, known for his work on the applications of electricity.

JULES CARPENTIER, known for his work on the designing and manufacture of electrical and scientific apparatus, member of the Paris Academy of Sciences, has died at the age of seventy years.

PROFESSOR OSWALD SCHMIEDEBERG, formerly professor of experimental pharmacology in Strasbourg, died in Baden-Baden on July 12, at the age of 82.

PROFESSOR N. A. CHOLODKOVSKY, author of works on entomology and helminthology, professor emeritus in the Academy of Medicine and at the Institute of Forestry, has died in Petrograd at sixty-one years of age. Professor Cholodkovsky was also a distinguished poet.

A REUTERS dispatch from Christiania dated August 13 states that a telegram to the *Aftenpost* from Hammerfest says that the expedition sent to Siberia to search for Tessem and Knudsen, the missing members of the Amundsen expedition, failed to find any trace of the

men at Cape Wild, where they were supposed to be. Two members of the relief expedition will continue the search in Northwest Siberia.

The Lange Koch expedition which left Denmark last year and wintered in Melville Bay started for Peary Land on March 15. There has been some difficulty in the transport across Melville Bay as the Cape York Eskimos hired for this task had not arrived, but it is hoped that everything was got across safely.

Dr. J. Charcot, the French polar explorer, sailing in the North Atlantic in his exploring vessel, the *Pourquoi Pas,* has succeeded in landing upon the islet of Rockall, which lies some 260 miles west of the Hebrides and 185 miles from St. Kilda.

The Antarctic expedition by Sir Ernest Shackleton planned to leave England on September 12. The steamer *Quest* was found to give inadequate accommodations for the increased personnel necessary after the program to be followed was increased, and alterations made on the ship delayed the work of fitting out the expedition.

The British Iron and Steel Institute met in Paris under the presidency of Dr. J. E. Stead on September 5 and 6.

The *Scientific American,* long the leading weekly American journal of industry, invention and science, will hereafter be published monthly in combination with *The American Scientific Monthly.*

Several hundred American engineers will meet with representatives of the principal engineering societies of Great Britain and France at a dinner to be given at the Engineers' Club in New York City on the evening of October 10. The dinner, while formally celebrating the homecoming of the mission of American engineers who went abroad to confer the John Fritz Medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris, will mark the launching of a new movement to bring English and American engineers together. The guests at the dinner will include the twelve members of the deputation which represented the John Fritz Medal Board and representatives of the British and French societies by which they were received. Invitations have been extended to many men prominent in public life, including Mr. Herbert Hoover, Secretary of Commerce; Viscount Bryce and Mr. Charles E. Hughes, Secretary of State. Others who will attend are the governing boards of the four national engineering societies, the John Fritz Medal Board of Award, the Library Board of the Engineering Societies and of the Engineers Club; the trustees of the United Engineering Society, and the officers of the Federated American Engineering Societies.

The *Journal* of the American Medical Association states that according to an agreement to improve their equipment and coordinate their personnel, the several public health agencies operating laboratories in Memphis on September 1 moved into their new quarters in the university laboratory. Dr. William Krauss, professor of preventive medicine and hygiene in the college of medicine for many years, has been made director of the laboratories, and his salary will be paid jointly by the agencies interested, which include the malarial research laboratory of the U. S. Public Health Service, the West Tennessee laboratory of the State Board of Health, the department of bacteriology of the University of Tennessee College of Medicine, and the laboratories of the Memphis department of health. The plan of coordination has received the endorsement of Dr. Frederick F. Russell, director of laboratories for the International Health Board.

Under the auspices of the Yale Medical School, the state of Connecticut and the Rockefeller Foundation will unite to finance the proposed Connecticut Psychopathic Hospital. The Rockefeller Foundation will provide $500,000, the state probably the same amount, while the share and part of Yale in the transaction is not determined. The hospital building will be erected by the state grant, the Rockefeller Foundation will supply the salaries for the teaching staff, while Yale may

supply the clinical quarters and other costs. As the New Haven General Hospital is now a part of the Yale Medical School, the Psychopathic Hospital is expected to supply the cases under observation. There will be a close connection between the new psychopathic hospital and the New Haven General Hospital. Details of arranging for the gift will come before the Yale Corporation at its next meeting. Governor Lake of Connecticut recently appointed a commission to take charge of the plans for expenditure of the state fund of $500,000 for the hospital. Dr. Paul Waterman, of Hartford, is chairman of the commission, and Dean Winternitz, of the Yale Medical School, is a member.

Nature says: "The classical experimental plots which Lawes and Gilbert started at Rothamsted have been of the greatest service to agricultural science, and their importance is constantly increasing. Fundamental questions in the physics, chemistry, and biology of agriculture can be attacked with more confidence in the light of results obtained from long-continued field experiments carried out on a systematic plan. Further, the results are capable of statistical examination. The importance of the Rothamsted experiments led to the institution of a parallel series at Woburn in 1876 by the Royal Agricultural Society. The Woburn soil is light and sandy, but that at Rothamsted is a heavy loam. The two series of experiments enable instructive comparisons to be made between these two soil types. All interested in agricultural science received with concern the decision of the council of the Royal Agricultural Society to relinquish—owing to economic conditions—the Woburn experiments. Fortunately the danger has been averted. Arrangements have been made for the experiments to be continued under the auspices of, but legally distinct from, the Rothamsted Experimental Station. The general portion of the Woburn farm will continue under the direct control of Dr. A. J. Voelcker, who for many years has carried out the duties on behalf of the Royal Agricultural Society. The new arrangement will not only ensure the continuance of the valuable work already done, but will also lead to a closer contact with the work of Rothamsted."

THE Directoria de Meteorologia e Astronomia of the Brazilian Department of Agriculture has been divided into two separate services "Directoria de Meteorologia 2" and "Observatorio Nacional." The division for meteorology has been placed under the direction of Dr. Sampaio Ferraz. It will continue the climatological work established in 1909, unifying methods of meteorological research and publishing all available data for the past ten years. It is planned to issue nine bulletins by the end of the year. The division will establish a forecast service for central and southern Brazil; an aerological service for aviators and kite and pilot balloon stations; a special coast service for navigation; an agricultural meteorological service; a marine meteorological service; a special service of rains and floods, and the usual investigations in every department of meteorology with especial reference to longer ranges in weather forecasting. Rio Grande do Sul, Minas Geraes and São Paulo continue their state services, but under the supervision of the Directoria. The Reclamation Service of semi-arid northeastern Brazil will maintain its rain organization.

STATISTICS relating to the growth of the population of France show that last year the excess of births over deaths was 159,790, as against 58,914 in 1913, while the number of marriages has doubled. It is the first time since the war that statistics have been available for the whole of France, including the three departments of Alsace-Lorraine. The births were 834,411 last year, compared with 790,355 in 1913—an increase of 44,056. The deaths were 674,621 against 731,441 in 1913—a decrease of 56,820. The marriages were 623,869 last year against 312,036 in 1913.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of the late John McMullen, president of the Atlantic, Gulf and Pacific Dredging Company, Cornell University will

receive a bequest estimated at from one to two million dollars.

Fire which resulted in damage to equipment of approximately $20,000 and to the building of about $28,000 was discovered in the attic of the Richardson Chemistry Building, Tulane University, New Orleans, on the morning of July 6.

Dr. J. M. Bell succeeds Dr. F. P. Venable as head of the department of chemistry at the University of North Carolina. Dr. Venable, who was formerly president of the university, has resigned as head of the chemistry department, but retains his professorship.

Dr. Eugene P. Deatrick has resigned as instructor of soil technology, College of Agriculture, Ithaca, N. Y., to become associate professor of soils, and head of department, West Virginia University, Morgantown, W. Va.

Dr. Reuben S. Tour has been appointed professor of chemical engineering at the University of Cincinnati. Dr. Tour, who succeeds Dr. O. R. Sweeney, who resigned because of ill health, has served for several years as an expert for the government on nitrate and other chemicals, and will continue to act as consulting expert for the government.

Dr. Chas. C. Macklin has resigned his position as associate professor of anatomy in Johns Hopkins University to accept the professorship of histology and embryology in Western University, London, Canada.

Professor H. Lebesque, of the faculty of sciences, University of Paris, has been elected professor of mathematics at the Collège de France.

DISCUSSION AND CORRESPONDENCE

SECULAR PERTURBATIONS OF THE INNER PLANETS

To the Editor of Science: It is true, as Professor Poor states (Science, Vol. 54, pp. 30–34, 1921), that if we are at liberty to assume any distribution of density we like around the sun it is not difficult to account for all the secular perturbations of the four inner planets within their mean square errors, by means of the Newtonian law of gravitation. Professor Poor, however, does not appear to have read much of the paper of mine to which he refers,[1] or he would have noticed that the density we are at liberty to assume is subject to very severe limitations. It is possible to estimate the density of the matter at any distance from the sun directly; for the amount of light it scatters is known from observations of the zodiacal light and the corona, and by considering different possible constituents, whose scattering powers for given masses are known, we can determine limits to the density. Seeliger and de Sitter succeeded in explaining the residual secular perturbations of the four inner planets by means of two ellipsoids of matter, one close to the sun, and the other extending to the orbit of the earth. I showed, however, in the paper referred to, that the density of the matter between the orbits of Mercury and Mars can not exceed $\frac{1}{600}$ of that required by these writers, and in a later paper[2] I showed that the disturbing effect of the matter near the sun can not exceed 10^{-9} of that supposed to be produced by their inner ellipsoid. Accordingly, none of the secular perturbations of the inner planets can be explained by means of the Newtonian law of gravitation. The fact that the excess motion of the perihelion of Mercury is accounted for by Einstein's law therefore decides definitely in favor of the latter. Further, Einstein's law is the simplest that can account for it. None of the other nine residuals exceeds 3 times the corresponding mean error, and only three of them the mean error itself, and there is therefore no reason to regard them as anything but accidental errors.

Harold Jeffreys

St. John's College,
Cambridge, England

1 "The Secular Accelerations of the Four Inner Planets," *Monthly Notices*, R. A. S., Vol. 77, pp. 112–118, 1917.

2 "On the Crucial Tests of Einstein's Theory of Gravitation," *loc. cit.*, Vol. 80, pp. 138–154, 1919.

SPOROZOAN INFECTION

To the Editor of Science: I have just detected, in an American recently arrived in the Philippine Islands from the United States, a case of infection with *Isospora hominis* Rivolta, 1878 (emend Dobell, 1919). Circumstances connected with the case lead me strongly to suspect that the infection was contracted in the United States. Inspection of the recent literature has disclosed that since 1918, at least eleven cases of sporozoan infection (including *Isospora*) have been discovered in the United States. Four of these cases apparently are autochthonous. They will be found in the tables accompaning papers by Kofoid and his coworkers,[1, 2] on the examination of overseas and home service troops in New York. These findings have escaped comment for one reason or another and, as the patient studied by me has never been in any part of Europe—much less the Eastern Mediterranean area where coccidial infections seem to be endemic, I consider we have reason to suspect that dissemination of the parasite is occurring among the civilian population of the United States.

We have little knowledge of the clinical manifestations of "human coccidiosis" and no knowledge of its pathology. Reports indicate that the parasite is not especially harmful to adults, but too much should not be assumed in this direction. Especially should we be watchful for infections in children and in people of lowered vitality. The cysts of the coccidia are highly resistant to desiccation, and to the action of chemicals and disinfectants, and they remain viable for long periods of time—much longer than do the cysts of other intestinal protozoa infesting man, so that the parasite presents a difficult problem in epidemiology.

All available information should be gathered at this time, regarding the incidence of human coccidiosis in the United States, for it may be possible to trace the cases originating in the soldiers already observed, and other cases that it is not unlikely have originated from them by this time. Such studies can not begin too early. With the object of aiding such an investigation, I am, by authority of Professor Elmer D. Merrill, director of the Bureau of Science, sending preserved material from our case to the following specialists, where it will be available for comparison with any material that may be found in the United States:

Professors Gary N. Calkins, Columbia University, New York; Robert W. Hegner, Johns Hopkins University, Baltimore, Md.; Henry B. Ward, University of Illinois, Urbana, Ill.; Charles A. Kofoid, University of California, Berkeley, Calif.; R. B. Gibson, Iowa State University, Iowa City, Ia.; Ernest E. Tyzzer, Harvard University Medical School, Boston, Mass.; Kenneth M. Lynch, Medical College of the State of South Carolina, Charleston, S. C.; James C. Todd, University of Colorado, Boulder, Colo.; Mark F. Boyd, University of Texas, Galveston, Tex.; and Allen J. Smith, University of Pennsylvania.

Frank G. Haughwout

Bureau of Science,
Manila, P. I.

1 Kofoid, Kornhauser and Plate, *Jour. Amer. Med. Assoc.*, Vol. 72, p. 1721, 1919.

2 Kofoid and Swezy, *N. O. Med. and Surg. Jour.*, Vol. 73, pp. 4–11, 1920.

SCIENTIFIC LITERATURE AND APPARATUS FOR ROUMANIA

To the Editor of Science: You were so kind as to publish in Science (April 8) my letter in which I showed: (1) That our Institutions do not possess American books and instruments; (2) that the disadvantageous exchange of our money since the war, prevents us from making scientific purchases in the United States; (3) that means should be found to remove a difficulty that hinders scientific relations.

This letter provoked the interest of the American universities and intellectuals. I received not only approvals but also gifts consisting of books and even scientific instruments.

We accept with gratitude all these manifestations of sympathy, but they do not

bring the practical solution of our question.

The institutes of our university have funds that would be sufficient if the value of the dollar were of 5 lei, as it was before the war, and not 90–100 lei as it is now. The credits assigned to our laboratories, even augmented, can not meet at the same time the general rise in price of scientific materials and the disadvantageous exchange of our money.

The solution of this great difficulty might be found, I think, in the organization of a credit with a fixed term of payment in 3 or 4 years. Such credits were organized during the war for the supply of engines of destruction; why should it be impossible to organize them in a time of peace in order to facilitate scientific cooperation and for the benefits of science?

I think that this organization might be created. Under the auspices of an American scientific association a number of booksellers and instrument makers might be grouped, forming a society which would divide among them the orders of our institutions centralized by the chancellor of the university.

The total sum forming the price of the objects, guaranteed by the university, would be divided into two fractions: one part payable immediately and another credited for 3 or 4 years, with a fixed annual interest. Our universities are state institutions and offer every guaranty of solvency.

I beg again the friends of science and of international cooperation to be willing to examine the question also from this point of view and seek the solution of the organization of this credit. Our university is ready to make every sacrifice in its power in order to secure practically and permanently the cooperation of American science.

E. G. Racovitza

Institute of Speology,
University of Cluj,
Roumania

AMERICAN SCIENTIFIC LITERATURE FOR FOREIGN COUNTRIES

In Science, Volume 53, page 335, April 8, 1921, Professor Racovitza, of the University of Cluj, Roumania, points out that his university is practically barred from access to the American scientific literature and scientific instruments by the present state of foreign exchange. He points out that Science, which before the war cost thirty-five Roumanian lei, now costs five hundred and ninety-five lei.

The Biological Club of the University of Minnesota believe that such a situation should not exist and that American scientific literature should be widely disseminated in Europe. Obviously, however, the University of Cluj can not purchase many American journals at such a rate of exchange. Accordingly the secretary of the Biological Club was authorized to write Professor Racovitza and ask him for a list of journals which he would prefer to have in their library. In a letter under date of July 16, he submits the following list in order of his preference: (1) *The American Naturalist,* (2) *Ecology,* (3) *Genetics,* (4) *Journal of General Physiology* (Loeb), (5) *Journal of Morphology,* and (6) *Journal of Experimental Zoology.*

The Biological Club is accordingly asking the publishers of *The American Naturalist* to send that journal to the library of the Institutul De Speologie, Universitatea Din Cluj, and bill the subscription price to the Club until further orders.

We are publishing this note in Science in the hope that similar scientific organizations will take like action. In case such action is taken by any organization it is suggested that it might be advisable in order to avoid sending duplicate journals to their library that a central clearing house of some sort should be established. If this seems best the undersigned would be glad to serve in this way.

H. D. Barker,
Secretary of the Biological Club

THE TRUTH ABOUT VIVISECTION

To the Editor of Science: In the *Womans Home Companion* for July, 1921, is the best paper on this subject I have ever seen called "The Truth about Vivisection" by Mr. Ernest Harold Baynes. Mr. Baynes first read

the literature on both sides and then visited practically all the laboratories from the Mayos' at Rochester, Minnesota, to the eastern seaboard. He visited especially the Rockefeller Institute several times, also a number of European laboratories. He became thoroughly convinced (1) that the experiments were not cruel, (2) that the statements in the literature of the antivivisectionists were often garbled and utterly misleading, and (3) that the results to animals themselves as well as to human beings were of enormous benefit. Then he wrote the article, and Miss Lane, the editor of the *Companion,* bravely printed it.

The especial significance of *his* writing such an article lies in his nation-wide reputation as a lover of animals and their protector. He is the father of all the bird-refuges in the United States. His lectures on animals have been heard everywhere, and when *he* approves of experiments on animals every one knows that he has good reasons for so doing.

The fury of the antivivisectionists at once rose to fever heat. The New York Antivivisection Society through its president, Mrs. Belais, sent out an extraordinary appeal calling him "one Ernest Harold Baynes"—almost as if one should write "one Herbert Hoover"! In a paragraph all in capitals Mrs. Belais called on all lovers of animals to help crush Miss Lane financially not only by cancelling their own subscriptions but by urging all their friends to do the same—a nationwide boycott. This extraordinary method will ensure a reaction in favor of Miss Lane because of its vindictive unfairness. It is not argument, it is persecution and is also illegal.

It behooves the friend of scientific research and *real* lovers of animals to support Miss Lane by expressing to her by mail their admiration of her courage, and by adding their own names to the list of her subscribers. Her address is 381 4th Ave., New York, and the cost of a year's subscription is only two dollars. She has received hundreds of letters from the A-Vs—many abusive. The November and succeeding issues will contain some interesting reading.

Mr. Baynes has also been attacked by mail and by cancellation of engagements. It is up to us to sustain so doughty a champion. He has given the antivivisectionists the hardest blow I have known in 40 years.

W. W. Keen

QUOTATIONS

CHEMISTRY AND THE PUBLIC

It is fitting that 3,000 British, Canadian, and American chemists should be sitting together at Columbia University, for they have been acting together for seven years. The chief feature of American chemical history after 1914 was the remarkable cooperation of American and Allied—especially British—chemists upon problems pertaining to munitions and other war essentials. They found themselves faced by a Germany which had built up its chemical industries by decades of shrewd effort. As Mr. Garvan said on Wednesday, the Germans had taken the discoveries of the British chemist Perkin—the Perkin Medal is one of our most prized scientific awards—and had made it the basis for a chemical technology unapproached elsewhere. Happily, we were able to build up some branches of industrial, agricultural, and electrical chemistry with a speed that surprised those who were unacquainted with our resourcefulness and our skill in research. By the end of 1915 the United States had the largest aniline plant in the world and was credited with nitric acid and nitro-cellulose plants three times greater than any others.

Not since Syracuse waited for the inventions of Archimedes to beat off the Romans has attention been concentrated upon science in war-time as Americans concentrated it upon chemistry after 1917. We had been shocked into a realization that we had depended upon Germany for medicines and dyes; that we had developed no independent potash resources; that we had done little with our Louisana sulphur; that we had looked to Chile for nitrates which we should have manufactured in part for ourselves, and that we had wasted the precious by-products we might

have gained from coking. The results of our awakening are shown in the newly issued summary of the 1920 census. In 1914 the United States had 754 establishments manufacturing chemicals, with products worth $200,195,800. In 1920 it had 1,374 establishments, with products worth $694,643,000. The increase in the value of the products in six years was 247 per cent. The manufacture of potash and potassium products was slightly more than twice as great—measured in value —as in 1914; that of acids about two and a half times as great; that of sodas and sodium almost three times as great, and that of coal tar products was $133,340,000, as against $8,839,000 in 1914, or about fifteen times as great.

Gratifying as this progress is, the complexity of some essential chemical industries, the careful adjustments they must establish with other industries, render more progress necessary before we are safe. Leaders in the coal-tar business, which are vital to national defence, declare that although we have far surpassed all other nations except Germany and Switzerland, we need five years yet to make our position impregnable. For the time being many of our drug-making and dye-making firms—we had 213 companies making these and other coal-tar products last year—have a right to complete tariff protection. The chemists at Columbia University have adopted resolutions asking for a "selective embargo." Any embargo needed in certain parts of this field can and should be provided by wise tariff legislation, and not, as some demand, by the arbitrary decrees of a licensing bureau.—*New York Evening Post.*

SPECIAL ARTICLES

TRIPLOID INTERSEXES IN DROSOPHILA MELANOGASTER[1]

In an experiment made to determine the locus of the new second-chromosome recessive mutant "brown" by means of a back-cross with the well-known second-chromosome recessives plexus and speck, one culture was found that produced a total of 96 females, 9 males, and about 80 individuals that were intermediates between males and females.

The "intersexes," which were easily distinguished from males and from females, were large-bodied, coarse-bristled flies with large roughish eyes and scolloped wing-margins. Sex-combs (a male character) were present on the tarsi of the fore-legs. The abdomen was intermediate between male and female in most characteristics. The external genitalia were preponderantly female. The gonads were typically rudimentary ovaries; and spermathecæ were present. Not infrequently one gonad was an ovary and the other a testis; or the same gonad might be mainly ovary with a testis budding from its side. The intersexes showed considerable variation, apparently forming a bimodal group—on the one hand a more "female-type," the extreme individuals of which might even lack sex-combs, and, on the other hand, a more "male-type," many of the individuals having large testes and normal male genitalia. All intersexes proved sterile.

Just as striking as the production of intersexes was the fact that the 96 females and 9 males of that same culture showed three, instead of two, large classes representing original combinations, namely, plexus speck, plexus brown, and brown speck. Extensive tests were made of these flies; and each was found to have received from the father a second-chromosome carrying plexus brown and speck, and to have received from the mother one of three different second-chromosomes, namely, a plexus brown, or a plexus speck, or a brown speck chromosome. That is, the mother of the intersexes had carried *three* second-chromosomes, instead of two. For each of the loci plexus, brown and speck she had carried two recessive genes for the mutant character and one wild-type allelomorph, with nearly complete dominance of the wild-type gene in each case.

A condition of triploidy for certain sections of chromosome had been met with in the previous (unpublished) studies on duplications and on translocation; but that this triploidy was far more extensive soon became evident.

[1] Paper read before the Pacific Division A. A. A. S., Univ. of Cal., Aug. 5, 1921.

The third-chromosome recessive "white-ocelli" had been present in the original culture; and tests of the flies produced by that culture showed that white-ocelli was being distributed in the same abnormal fashion as were plexus brown and speck. Not only were the second- and third-chromosomes involved, but the X-chromosome as well, as was shown by specific tests with sex-linked characters.

The hypothesis that the intersexes were triploid was easily put to test by direct cytological examination. The chromosomes (which were unusually clear and well separated) consisted of two sets of three V's (the two sets differing in the size of the V's), a pair of rods, three or two small round chromosomes, and a J-shaped chromosome or not. That is, all intersexes possessed the second- and the third-chromosomes in triplicate and the X- in duplicate, but they might possess three or two fourth-chromosomes, and have or lack a Y-chromosome, so that four sub-types of intersex constitution were found.

About ten per cent. of the daughters from the original culture, when tested, produced in turn intersexes and further disturbances of the linkage ratios. These females were presumably triploid for all the chromosomes (except the fourth, which might be present in duplicate). It was then discovered that these intersex-producing females could be identified by their somatic characters, which were similar to, but less extreme than, those of the intersexes—namely, large size, coarse bristles, and large roughish eyes. Stocks producing triploids and intersexes were maintained more easily by taking advantage of the fact that triploid females carrying two white and one eosin gene have a pale yellow eye-color lighter than that of their diploid white-eosin sisters, and likewise that the third-chromosome dominant Delta is dominant over two recessive non-Delta genes, but the triploid heterozygote is markedly different from the diploid heterozygote.

With material from these stocks genetical proof was obtained that the intersex-producing females possess in triplicate the loci for a large variety of first-, second- and third-chromosome genes, and that they might possess fourth-chromosome loci in triplicate or in duplicate. This genetical finding, checked by cytological examination, extends the direct proof of the chromosome theory of heredity to specific second- and third-group mutant characters and specific V-shaped chromosomes. Such direct proof had already been provided for certain sex-linked mutants and the rod-shaped chromosomes by the phenomena of non-disjunction of the X-chromosomes,[2] and more recently for the small round chromosome and the mutants of the "fourth" group through study of "Diminished" individuals haploid for that chromosome because of non-disjunction.[3]

In the triploid strain individuals triploid for the fourth-chromosome alone have been identified as a distinct somatic type, tested genetically in a variety of ways, and proved to be such by direct cytological examination.

A significant new conclusion proved by the intersexes is that sex in *D. melanogaster* is determined by a balance between the genes contained in the X-chromosome and those contained in the autosomes. It is not the simple possession of two X-chromosomes that makes a female, and of one that makes a male. A preponderance of genes that are in the autosomes tend toward the production of male characters; and the net effect of genes in the X is a tendency to the production of female characters. The ratio of $2X$: 2 *sets autosomes,* or $3X$: 3 *sets autosomes* (or $1X$: 1 *set autosome?*) produces a female, while $1X$: 2 *sets autosomes* produces a male. An intermediate ratio, $2X$: 3 *sets autosomes,* produces an intermediate condition—the intersex. The fourth-chromosome seems to have a disproportionately large share of the total male-producing genes; for there are indications that the triplo-fourth intersexes are preponderantly of the "male-type," while the diplo-fourth intersexes are mainly "female-type."

The condition $3X$: 2 *sets autosomes* should be "super-females," and $1X$: 3 *sets autosomes* "super-males." Triploid females produce a

[2] *Genetics,* 1, 1916.

[3] In press, *Proc. Nat'l Acad.*

small proportion of males that are somatically quite different from males and from intersexes and that are sterile. There is genetical evidence that these males are $1X : 3$ *sets autosomes* in constitution. Studies of "high non-disjunction" show that triplo-X individuals ordinarily die, but in certain lines they occasionally survive as females that are somatically quite different from diploid or triploid females and that are sterile. Such females occur also in the progeny of triploid females; and, in the case of those produced by non-disjunction, both genetical and cytological proofs of their constitution ($3X : 2$ *sets autosomes*) are now complete.

CALVIN B. BRIDGES

THE AMERICAN CHEMICAL SOCIETY

(Concluded)

DIVISION OF DYE CHEMISTRY

A. B. Davis, *chairman*
R. Norris Shreve, *secretary*

Contribution to the estimation of H acid: H. R. LEE. The stability of diazo-benzene and p-diazo-toluene is taken up from the standpoint of their use as standard volumetric solutions. Data showing the relative stability of these diazo salts both in acid and alkaline solution are presented. Tables showing comparative analyses of a large number of samples of commercial and pure H acids are given. The method used by the Newport Company for the analysis of H acid is outlined. The use of p-diazo-toluene for the analysis of a number of amino-naphthol-sulfonic acids other than H acid is suggested.

A new alizarin process: CHAS. W. SCHAFFER. This process depends on a cheap process for manufacture of pyrocatechol and then the synthesis of alizarin according to Baeyer and Caro from pyrocatechol and phthalic anhydride. Phenol is nitrated and reduced wth zinc giving ortho and para amino-phenol. This is diazotized, not filtered and the diazo solution run directly into the still. In the distillation the diazonium chloride, being unstable, is decomposed—water and acid first coming off—and at 243–245° C. the pure pyrocatechol comes over. The p-amino-phenol may also be diazotized and sublimed, giving hydroquinone.

Bleaching of dyed cotton fabrics: J. MERRITT MATTHEWS. Owing to the demand of the American public for more cotton goods with larger variety of colors it was necessary to modify the old-fashioned method of bleaching in order to properly preserve the color and also to produce a satisfactory bleached fabric. The extension of cotton goods in the field of wearing apparel has been made possible to great degree by the fact that a variety of color effects can now be employed. This has been very beneficial to many of our manufacturing enterprises and has also made it possible to use the cheaper staple cotton in place of the more expensive staples of wool and silk. Furthermore, it has led to the development of apparel materials which can meet the conditions of modern treatment in the laundry. There is an ever increasing demand for faster dyes owing to the fact that modern methods of usage are such as to put a very severe burden on the color. It has been the endeavor of the dyestuff manufacturers to increase continually the line of such fast dyes for the purpose not only of enlarging the color palette, but also of simplifying the method of dyeing so that the dyer is not more inconvenienced by the use of these fast dyes than he would be by using the more fugitive colors.

The immediate needs of chemistry in America: WILLIAM J. HALE. The industries are fast ridding themselves of poorly trained chemists and hence the recent period of business depression has come in this respect like a godsend to chemistry in America. A classification of chemists everywhere is attempted. In order that industrial advancement may be made all the more apparent, the highest development of the several classes of chemists is an absolute necessity. Four distinct factors constitute the immediate needs of chemistry in America, the most pertinent being the development of chemists with engineering training. In fact, physics and engineering are no less important than chemistry itself in the training of the young chemist. The greatest need for the future as well as for the present is the collaboration of universities and industries upon researches which take their rise from industrial problems.

Contribution to the chemistry of malachite green: JOSEPH R. MINEVITCH. Tetramethyldiamidotriphenyl methane, which is prepared by the condensation of dimethylaniline and benzaldehyde in the presence of hydrochloric acid, when oxidized with lead peroxide as a solution of the dihydrochloride either with or without sufficient acetic acid does not give exclusively the tetramethyldiamidotriphenyl carbinol. The tetracarbinol possesses crystalline properties and forms mala-

chite green crystals either as the oxalate or the zinc double chloride salt. What actually does form in this reaction is a mixture of carbinols, one of which—probably a triphenyl derivative—possesses little or no crystalline properties and forms amorphous salts with oxalic acid or zinc chloride. Hydrochloric acid corresponding to the methane dihydrochloride and in the presence of at least 2.25 molecules of acetic acid gives the maximum of tetramethyl derivative. Oxidation without acetic acid produces a carbinol or a mixture of carbinols which is so weak in crystalline properties as to form little or none of the crystalline malachite green salts.

Imports of dyes by classes during 1920: C. R. DE LONG. The following import statistics are presented:

Vat dyes other than indigo.	855,000 lbs.
Mordant and chrome dyes...	840,000 lbs.
Acid dyes	765,000 lbs.
Direct dyes	595,000 lbs.
Sulfur dyes	255,000 lbs.
Basic dyes	200,000 lbs.
Indigo	171,000 lbs.

Dyes derived from beta-oxynaphthoic acid and from J-acid with reference to the Chemical Foundation patents: A. WILLIARD JOYCE. The colors made from beta-oxynaphthoic acid are mostly insoluble in water and oil, and are of special interest to the makers of lake-pigments. Those derived from the arylamides of beta-oxynaphthoic acid are of value as pigments and also as colors developed directly on cotton when used in combination with a diazotized arylamine. This class of colors has been developed chiefly by the German firms of Meister Lucius and Bruning and Griesheim-Elektron. The dyes derived from J-acid are valuable direct cotton colors of good fastness, especially to acids and of great clearness and brilliancy of shade. These colors from J-acid and J-acid derivatives have been greatly developed by leading German dye manufacturers: the Bayer Company, Cassella and Co., Meister Lucius and Bruning, and Kalle and Co. The Chemical Foundation, Inc., owns patents which cover dyes made from the above intermediates.

The quantitative determination of phenanthrene: ARTHUR G. WILLIAMS. Phenanthrene in crude phenanthrenes may be quantitatively determined by oxidation in glacial acetic acid solution by iodic acid to phenanthraquinone followed by precipitation of the quinone, also in glacial acetic acid solution, as toluphenanthrazine by 3,4-tolylene diamine. The hydrocarbon may be conveniently detected qualitatively by oxidation in glacial acetic acid solution by means of $KBrO_3$ or HIO_3 followed by precipitation by water, filtration, extraction of the residue by $NaHSO_3$, liberation of the quinone by means of HCl and $FeCl_3$, extraction with CCl_4, and final detection of phenanthraquinone by means of the Hilpert and Wolf test with $SbCl_5$ in CCl_4.

Alkali fusions. III. Fusions of phenylglycine o-carboxylic acid with potassium hydroxide and with sodium hydroxide for the production of indigo: MAX PHILLIPS.

Vapor pressure determinations on naphthalene, anthracene, phenanthrene, and anthraquinone between their melting and boiling points: O. A. NELSON and C. E. SENSEMAN.

Nomenclature of dyestuff intermediates: J. WARREN KINSMAN.

SECTION OF PETROLEUM CHEMISTRY

T. G. Delbridge, *chairman*
W. A. Gruse, *secretary*

Petroleum hydrocarbons that can not be distilled: C. F. MABERY.

Petroleum: a raw material for our chemical industries: SIDNEY BORN.

Some chemical considerations of petroleum refining: B. T. BROOKS. Chemical investigation has played a relatively unimportant part in the petroleum industry. Reasons advanced for this are: (1) Petroleum has been plentiful and crude methods profitable. (2) Research has been regarded as unprofitable "wild catting." (3) Initiative and spirit of research has been killed by the policy of secrecy. (4) Petroleum technologists are unorganized and inarticulate. (5) Fundamental or theoretical research in this branch of organic chemistry has been comparatively neglected. (6) Chemists have been poorly and narrowly trained. Several factors which are improving this situation are given. It is important to minimize refining losses. Many opinions previously held in regard to olefines are untenable.

Oil shale: R. F. BACON.

Determination of gasoline in natural and casinghead gas: CHARLES SKEELE PALMER.

Dechlorination of chlorohydrocarbons: W. F. FARAGHER and F. H. GARNER.

Determination of moisture in transformer oils: C. J. RODMAN.

Viscosity—temperature curves of fractions of typical American crude oils: E. W. Dean and F. W. Lane.

Iodine numbers of unsaturated hydrocarbons and cracked gasolines: W. F. Faragher, F. H. Garner and W. A. Gruse.

The reclamation of used motor oils: William F. Parish. The disposal of used motor oils is becoming a serious problem. The chief reason for their poor quality, as recovered from the motor, is the dilution with approximately 30 per cent. of heavy ends from motor fuel. By washing with a water solution of soda ash and distilling off the diluent, airplane motor oils were recovered ten times and more at one aviation camp during the war and gave better service than new oils. The improvement in recovered oils is due to the removal of low boiling constituents.

Total heats and condensation points of kerosene-air mixtures: Robert E. Wilson and D. P. Barnard.

A new method of color measurement for oils: Leon W. Parsons and Robert E. Wilson.

Catalytic oxidation of petroleum oils: C. E. Waters.

Viscosities of motor oils at high temperatures: L. B. Lockhart. (By title.)

DIVISION OF WATER, SEWERAGE AND SANITATION

W. P. Mason, *chairman*
W. W. Skinner, *secretary*

Reactions in the Dorr-Peck tank: A. M. Buswell.

Definition of alkalinity and temporary hardness: A. M. Buswell.

Notes on the analysis of mine drainage water: Joseph A. Shaw and N. A. Bailey.

Method for the determination of free and combined carbon dioxide: Joseph A. Shaw.

Radioactivity of miscellaneous waters examined in the Bureau of Chemistry: W. W. Skinner and J. W. Sale. Analyses of radioactivity of eleven spring waters collected at source by a representative of the Bureau of Chemistry, of eight river, lake and ocean waters, of fifteen commercial domestic bottled waters, and of twelve imported bottled waters, are tabulated. The significance of the data depends on the fact that no commercial bottled water of natural origin has been found to contain sufficient radioactivity, either temporary or permanent, to warrant its purchase by consumers because of its content of radioactivity. In order to obtain the minimum daily dose of emanation from the most radioactive sample examined, it would be necessary to consume 2,810 gallons of water daily, and to obtain the minimum daily dose of radioactive salt from the most radioactive sample examined, it would be necessary to consume 2,935 gallons of water daily. To obtain the maximum doses, it would be necessary to consume daily at least ten times these amounts, or 28,100 and 29,350 gallons of water respectively. It is concluded, therefore, that shippers of bottled waters are not justified in making any statments on the labels which will induce prospective consumers to purchase the articles because of their radioactivity.

A comparison of some miscellaneous samples of ocean, bay and lake waters: W. W. Skinner and W. E. Shaefer. In considering the composition of a water, two things must be borne in mind, (1) the amount of dissolved mineral matter per unit volume which may be termed the concentration of the water, and (2) the character or composition of this dissolved mineral matter. The waters of Chesapeake Bay near Chesapeake Beach, of the Gulf of Mexico off Galveston, Texas, of the Atlantic Ocean off Boston, and of the Pacific Ocean off San Francisco, while varying in concentration, are shown to contain the same constituents in almost exactly the same relative proportions. Therefore, the mineral matter dissolved in the rivers flowing into Chesapeake Bay and the Gulf of Mexico does not materially affect the composition of those waters. Although the concentration of the sea water is greater at rising tide than at falling tide, yet the percentage composition of the dissolved mineral matter in the water remains practically unaffected by the inflow and outflow of the tide. The mineral matter dissolved in certain North Dakota and Utah lakes is somewhat similar in composition to the mineral matter dissolved in Atlantic Ocean water. However, the difference in calcium content between these North Dakota and Utah lakes is noteworthy. The dissolved mineral matter in the three North Dakota lakes contains 4.54 per cent. calcium, while that in the six Utah lakes contains only 0.92 per cent. calcium. These lakes are from one fifteenth to two and three quarters times as concentrated as Atlantic Ocean water.

The present status of chlorination of public water supply: S. T. Powell.

Charles L. Parsons,
Secretary